AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (currently amended): A motor control device comprising:

a velocity calculation unit that calculates an actual velocity from a detected position that is a position of a motor or of a load connected to the motor, the detected position being detected by a detector;

a velocity control unit that performs velocity control to cause the actual velocity to follow a velocity command and outputs a q-axis current command;

a uvw/dq coordinate converting unit that receives a three-phase current detected in an inverter, performs coordinate conversion from a uvw three-phase coordinate system at rest into a dq synchronous rotation coordinate system, and outputs a d-axis current detection value and a q-axis current detection value;

a current control unit that receives a d-axis current command, the q-axis current command, the d-axis current detection value ~~feedback~~, and the q-axis current detection value ~~feedback~~, performs current control so that a dq-axis current detection value ~~actual current~~ coincides with a dq-axis current command, and outputs a d-axis voltage command and a q-axis voltage command;

a dq/uvw coordinate converting unit that receives the d-axis voltage command, the q-axis voltage command, and the detected position, performs coordinate conversion from the

dq synchronous rotation coordinate system into the uvw three-phase coordinate system at rest, and outputs a three-phase voltage command; ~~and~~

an inverter that receives the three-phase voltage command, applies an actual three-phase voltage to the motor, and drives the motor at a variable velocity; ~~, characterized by comprising:~~

a superimposed signal generating unit that outputs a superimposed signal of a repetitive waveform, such as a triangular wave or a sine wave;

a d-axis current command generating unit that adds the superimposed signal generated by the superimposed signal generating unit to a d-axis current command nominal value ~~the d-axis current command~~ and outputs the d-axis current command; and

an axial misalignment detecting unit that receives the d-axis current command and the q-axis current command output from the velocity control unit and outputs an axial misalignment angle estimation value.

2. (currently amended): The motor control device according to claim 1, ~~characterized by~~ further comprising a position control unit that receives a position command and the detected position detected by the detector, performs position control to cause the detected position to follow the position command, and outputs a velocity command to the velocity control unit-, ~~and characterized in that~~

wherein the superimposed signal generating unit outputs the superimposed signal of the repetitive waveform, such as a triangular wave or a sine wave.

3. (currently amended): A motor control device comprising:

a velocity calculation unit that calculates an actual velocity from a detected position that is a position of a motor or of a load connected to the motor, the detected position being detected by a detector;

a uvw/dq coordinate converting unit that receives a three-phase current detected in an inverter, performs coordinate conversion from a uvw three-phase coordinate system at rest into a dq synchronous rotation coordinate system, and outputs a d-axis current detection value and a q-axis current detection value;

a current control unit that receives a d-axis current command, a q-axis current command, the d-axis current detection value~~feedback~~, and the q-axis current detection value~~feedback~~, performs current control so that a dq-axis current detection value ~~actual current~~ coincides with a dq-axis current command, and outputs a d-axis voltage command and a q-axis voltage command;

a dq/uvw coordinate converting unit that receives the d-axis voltage command, the q-axis voltage command, and the detected position, performs coordinate conversion from the dq synchronous rotation coordinate system into the uvw three-phase coordinate system at rest, and outputs a three-phase voltage command; ~~and~~

an inverter that receives the three-phase voltage command, applies an actual three-phase voltage to the motor, and drives the motor at a variable velocity;~~, characterized by comprising:~~

a superimposed signal generating unit that outputs a superimposed signal of a repetitive waveform, such as a triangular wave or a sine wave;

a d-axis current command generating unit that adds the superimposed signal ~~idh~~ generated by the superimposed signal generating unit to a d-axis current command nominal value ~~the d-axis current command~~ and outputs the d-axis current command;

a torque current error calculation unit that receives the actual velocity output from the velocity calculation unit and the q-axis current command, and estimates a torque current error actually occurring in the motor; and

an axial misalignment detecting unit that receives the d-axis current command and the torque current error, and outputs an axial misalignment angle estimation value.

4. (currently amended): The motor control device according to claim 3, ~~characterized by~~ further comprising a velocity control unit that performs velocity control to cause the actual velocity to follow a velocity command, and outputs the q-axis current command, ~~characterized in that~~

wherein the superimposed signal generating unit outputs the superimposed signal of the repetitive waveform, such as a triangular wave or a sine wave.

5. (currently amended): The motor control device according to claim 1, ~~any one of claims 1 to 4, characterized by~~ further comprising an axial misalignment correction unit that receives the axial misalignment angle estimation value output from the axial misalignment detecting unit and the detected position detected by the detector, calculates a position after correction, and outputs the calculated position to the dq/uvw coordinate converting unit and the uvw/dq coordinate converting unit, ~~and characterized in that~~

wherein the dq/uvw coordinate converting unit and the uvw/dq coordinate converting unit perform the coordinate conversion on the basis of the position after correction.

6. (currently amended): The motor control device according to claim 5, wherein ~~any one of claims 1 to 5, characterized in that~~ the axial misalignment detecting unit includes:

a first input filter that filters the d-axis current command and outputs a d-axis signal for axial misalignment detection,

a second input filter that filters the q-axis current command or torque current error and outputs a q-axis signal for axial misalignment detection,

an adaptive input calculation unit that calculates an adaptive input by multiplying the d-axis signal for axial misalignment detection by the q-axis signal for axial misalignment detection,

a gain unit that multiplies the adaptive input by a gain and generates an integral input, and

an integrator that integrates the integral input and outputs the axial misalignment angle estimation value.

7. (currently amended): The motor control device according to claim 5, wherein ~~any one of claims 1 to 5, characterized in that~~ the axial misalignment detecting unit includes:

a first input filter that filters the d-axis current command and outputs a d-axis signal for axial misalignment detection,

a variable gain calculation unit that calculates a function of the d-axis signal for axial misalignment detection,

a second input filter that filters the q-axis current command or torque current error and outputs a q-axis signal for axial misalignment detection,

an adaptive input calculation unit that calculates an adaptive input by multiplying the function of the d-axis signal for axial misalignment detection and the q-axis signal for axial misalignment detection, and

an integrator that integrates the integral input and outputs the axial misalignment angle estimation value.

8. (currently amended): The motor control device according to claim 5, wherein ~~any one of claims 1 to 5, characterized in that~~ the axial misalignment detecting unit includes:

a first input filter that filters the d-axis current command and outputs a d-axis signal for axial misalignment detection,

a first sign detector that detects a sign of the d-axis signal for axial misalignment detection and outputs a sign-added d-axis signal for axial misalignment detection,

a second input filter that filters the q-axis current command or torque current error and outputs a q-axis signal for axial misalignment detection,

a second sign detector that detects a sign of the q-axis signal for axial misalignment detection and outputs a sign-added q-axis signal for axial misalignment detection,

an adaptive input calculation unit that calculates a sign-added adaptive input by multiplying the sign-added d-axis signal for axial misalignment detection by the sign-added q-axis signal for axial misalignment detection,

a gain unit that multiplies the sign-added adaptive input by a gain and generates an integral input, and

an integrator that integrates the integral input and outputs the axial misalignment angle estimation value.

9. (currently amended): The motor control device according to claim 5, wherein ~~any one of claims 1 to 5, characterized in that~~ the axial misalignment detecting unit includes:

a first input filter that filters the d-axis current command and outputs a d-axis signal for axial misalignment detection,

a second input filter that filters the q-axis current command or torque current error and outputs a q-axis signal for axial misalignment detection,

an estimation output calculation unit that multiplies the d-axis signal for axial misalignment detection filtered by the input filter by the axial misalignment angle estimation value to be described below, and outputs an estimation output,

an axial misalignment error calculation unit that finds a difference between the q-axis signal for axial misalignment detection filtered by the second input filter and the estimation output from the estimation output calculation unit and outputs an axial misalignment error,

a variable gain unit that multiplies the axial misalignment error output from the axial misalignment error calculation unit by a gain and outputs an integral input, and

an integrator that integrates the integral input output from the variable gain unit to obtain the axial misalignment angle estimation value.

10. (currently amended): A motor control device comprising:

a velocity calculation unit that calculates an actual velocity from a detected position that is a position of a motor or of a load connected to the motor, the detected position being detected by a detector;

a uvw/dq coordinate converting unit that receives a three-phase current detected in an inverter, performs coordinate conversion from a uvw three-phase coordinate system at rest

into a dq synchronous rotation coordinate system, and outputs a d-axis current detection value and a q-axis current detection value;

a current control unit that receives a d-axis current command, a q-axis current command, the d-axis current detection value~~feedback~~, and the q-axis current detection value~~feedback~~, performs current control such that a dq-axis current detection value~~actual current~~ coincides with a dq-axis current command, and outputs a d-axis voltage command and a q-axis voltage command;

a dq/uvw coordinate converting unit that receives the d-axis voltage command, the q-axis voltage command, and the detected position, performs coordinate conversion from the dq synchronous rotation coordinate system into the uvw three-phase coordinate system at rest, and outputs a three-phase voltage command;~~ and~~

an inverter that receives the three-phase voltage command, applies an actual three-phase voltage to the motor, and drives the motor at a variable velocity;~~, characterized by comprising:~~

a superimposed signal generating unit that sets the q-axis current command to zero and outputs a superimposed signal of a repetitive waveform, such as a triangular wave or a sine wave;

a d-axis current command generating unit that adds the superimposed signal generated by the superimposed signal generating unit to the d-axis current command and outputs the d-axis current command;

an axial misalignment detecting unit that receives the d-axis current command and the q-axis current command and outputs an axial misalignment angle estimation value;

a display unit that displays the axial misalignment angle estimation value;

a memory that stores the axial misalignment angle estimation value; and

an axial misalignment correction unit that receives the axial misalignment angle estimation value stored in the memory and the detected position, and outputs a position after correction.

11. (new): The motor control device according to claim 3, further comprising an axial misalignment correction unit that receives the axial misalignment angle estimation value output from the axial misalignment detecting unit and the detected position detected by the detector, calculates a position after correction, and outputs the calculated position to the dq/uvw coordinate converting unit and the uvw/dq coordinate converting unit,

wherein the dq/uvw coordinate converting unit and the uvw/dq coordinate converting unit perform the coordinate conversion on the basis of the position after correction.

12. (new): The motor control device according to claim 11, wherein the axial misalignment detecting unit includes:

a first input filter that filters the d-axis current command and outputs a d-axis signal for axial misalignment detection,

a second input filter that filters the q-axis current command or torque current error and outputs a q-axis signal for axial misalignment detection,

an adaptive input calculation unit that calculates an adaptive input by multiplying the d-axis signal for axial misalignment detection by the q-axis signal for axial misalignment detection,

a gain unit that multiplies the adaptive input by a gain and generates an integral input, and

an integrator that integrates the integral input and outputs the axial misalignment angle estimation value.

13. (new): The motor control device according to claim 11, wherein the axial misalignment detecting unit includes:

a first input filter that filters the d-axis current command and outputs a d-axis signal for axial misalignment detection,

a variable gain calculation unit that calculates a function of the d-axis signal for axial misalignment detection,

a second input filter that filters the q-axis current command or torque current error and outputs a q-axis signal for axial misalignment detection,

an adaptive input calculation unit that calculates an adaptive input by multiplying the function of the d-axis signal for axial misalignment detection and the q-axis signal for axial misalignment detection, and

an integrator that integrates the integral input and outputs the axial misalignment angle estimation value.

14. (new): The motor control device according to claim 11, wherein the axial misalignment detecting unit includes:

a first input filter that filters the d-axis current command and outputs a d-axis signal for axial misalignment detection,

a first sign detector that detects a sign of the d-axis signal for axial misalignment detection and outputs a sign-added d-axis signal for axial misalignment detection,

a second input filter that filters the q-axis current command or torque current error and outputs a q-axis signal for axial misalignment detection,

a second sign detector that detects a sign of the q-axis signal for axial misalignment detection and outputs a sign-added q-axis signal for axial misalignment detection,

an adaptive input calculation unit that calculates a sign-added adaptive input by multiplying the sign-added d-axis signal for axial misalignment detection by the sign-added q-axis signal for axial misalignment detection,

a gain unit that multiplies the sign-added adaptive input by a gain and generates an integral input, and

an integrator that integrates the integral input and outputs the axial misalignment angle estimation value.

15. (new): The motor control device according to claim 11, wherein the axial misalignment detecting unit includes:

a first input filter that filters the d-axis current command and outputs a d-axis signal for axial misalignment detection,

a second input filter that filters the q-axis current command or torque current error and outputs a q-axis signal for axial misalignment detection,

an estimation output calculation unit that multiplies the d-axis signal for axial misalignment detection filtered by the input filter by the axial misalignment angle estimation value to be described below, and outputs an estimation output,

an axial misalignment error calculation unit that finds a difference between the q-axis signal for axial misalignment detection filtered by the second input filter and the estimation output from the estimation output calculation unit and outputs an axial misalignment error,

a variable gain unit that multiplies the axial misalignment error output from the axial misalignment error calculation unit by a gain and outputs an integral input, and

an integrator that integrates the integral input output from the variable gain unit to obtain the axial misalignment angle estimation value.

16. (new): The motor control device according to claim 1, wherein the axial misalignment detecting unit includes:

a first input filter that filters the d-axis current command and outputs a d-axis signal for axial misalignment detection,

a second input filter that filters the q-axis current command or torque current error and outputs a q-axis signal for axial misalignment detection,

an estimation output calculation unit that multiplies the d-axis signal for axial misalignment detection filtered by the input filter by the axial misalignment angle estimation value to be described below, and outputs an estimation output,

an axial misalignment error calculation unit that finds a difference between the q-axis signal for axial misalignment detection filtered by the second input filter and the estimation output from the estimation output calculation unit and outputs an axial misalignment error,

a variable gain unit that multiplies the axial misalignment error output from the axial misalignment error calculation unit by a gain and outputs an integral input, and

an integrator that integrates the integral input output from the variable gain unit to obtain the axial misalignment angle estimation value.

17. (new): The motor control device according to claim 3, wherein the axial misalignment detecting unit includes:

a first input filter that filters the d-axis current command and outputs a d-axis signal for axial misalignment detection,

a second input filter that filters the q-axis current command or torque current error and outputs a q-axis signal for axial misalignment detection,

an estimation output calculation unit that multiplies the d-axis signal for axial misalignment detection filtered by the input filter by the axial misalignment angle estimation value to be described below, and outputs an estimation output,

an axial misalignment error calculation unit that finds a difference between the q-axis signal for axial misalignment detection filtered by the second input filter and the estimation output from the estimation output calculation unit and outputs an axial misalignment error,

a variable gain unit that multiplies the axial misalignment error output from the axial misalignment error calculation unit by a gain and outputs an integral input, and

an integrator that integrates the integral input output from the variable gain unit to obtain the axial misalignment angle estimation value.